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Review and Implementation of Technology for Solid Radioactive Waste Volume Reduction

1999 Annual Report

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Abstract
This paper addresses and outlines issues that will drive requirements for future training ranges. In response, to Army Transformation, Army training range capabilities need to transform to synchronize with and conform to the Legacy, Interim, and Objective Force's training needs. A sustainable training range transformation strategy will consist of a long-term, integrated, systems approach to developing and achieving a robust training venue by simultaneously addressing operational, environmental, and economic issues. This paper presents a discussion of operational issues in hopes that an Army training range transformation strategy will emerge that ensures and enables superior combat training opportunities for the Army's leaders, soldiers, and units.

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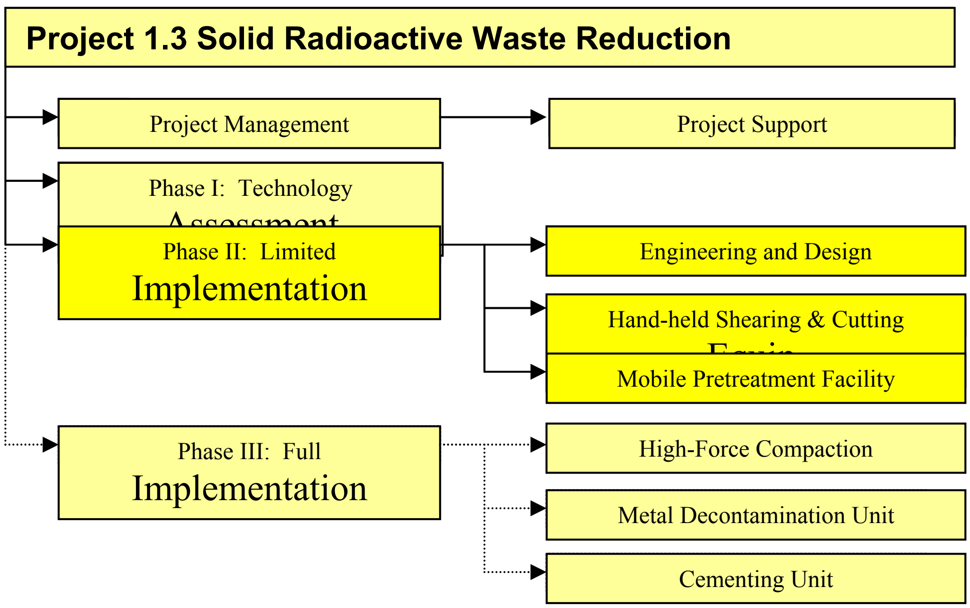
EXECUTIVE SUMMARY

Overview

Arctic Military Environmental Cooperation (AMEC) Project 1.3 is developing solutions to minimize the impact of solid radioactive waste (SRW) resulting from nuclear submarine decommissioning on the Arctic environment. The project is proceeding in a phased approach as illustrated below.



During 1999, the project direction has shifted and become more focused as the Russian shipyard needs have become better defined within the budgetary realities of the program. The result of this shift is the concept of a mobile pretreatment facility (MPF) that would permit solid waste sorting, volume reduction and containerization at current storage locations on the Kola Peninsula prior to transfer to a central processing facility (CPF) for final treatment and disposal. This is an important first step to stabilize the waste and reduce its volume so that ongoing decommissioning activities can continue. The CPF while still a goal of the project would entail a major expenditure of funds which is likely beyond the current AMEC program capabilities. However, the engineering assessment and planning of the CPF is within the current scope to ensure full compatibility and integration with the MPF operation.

Although the initial development of the MPF concept occurred in early March as a result of the joint Project Officers meeting held in conjunction with Waste Management 99 in Tucson, AZ, progress has been slowed by the breakdown in communications that

occurred over the crisis in Kosovo. Preparations have continued on all sides, but the coordination to work out contracts and specifications has not occurred. This has resulted in a schedule delay of over 5 months from the task management profile plan initially developed in Tucson.

Current plans are to issue a Request for Proposal on the MPF based on the interest expressed by 12 potential vendor teams to an earlier Request for Information. Russian involvement throughout this process is critical to ensure full buy in and compliance with regulating agencies. The selected vendor would develop an engineering design based on the conceptual drawings and discussions. The preliminary engineering design would be reviewed by the Russian contractor, Interbranch Coordination Scientific/Technical Center of Nuclide Production (ICC Nuclide), against the technical specifications and applicable regulations prior to finalization and authorization to construct. Design and construction is expected to take about a year to complete. Concurrently the Russians would clear the design through the various regulatory bodies and make preparations to receive and deploy the MPF.

Hand-held hydraulic cutting and shearing tools have been identified as a rapid deployment technology that would meet immediate needs in the shipyards and would be directly linked to the future MPF activities. These devices will directly address the types of waste expected and the planned mode of labor intensive manual operations. Rapid deployment of such tools will serve as a demonstration of their capabilities in advance of the MPF, and then complement the MPF operations once it is ready and delivered.

Conclusions

1) A change in direction, based upon first-hand observations of US technology and refinement of Russian needs, has resulted in the mobile pretreatment facility concept. This facility can be moved from site to site to stabilize and package solid wastes prior to the establishment of a central processing facility for final treatment and disposal.

2) A hand-held hydraulically-operated multiple-tool cutting and shearing system will provide improved functionality and performance over current capabilities for dismantling submarines and over the planned deployment of a skid steer tractor with a cutting attachment.

3) Close coordination and interchange of information between the international partners on the front end of the MPF procurement is required to avoid cost escalation and schedule delays once the equipment is ready for deployment.

Recommendations

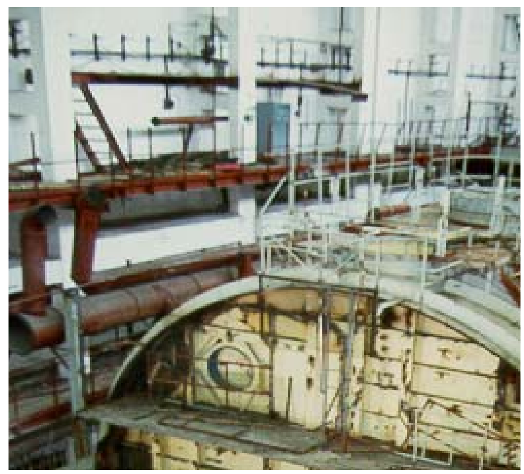
1) The US should proceed with the rapid deployment of the hand-held hydraulically operated cutting and shearing system as a demonstration of their capabilities at Russian shipyards in advance of the MPF deployment to provide experience in their use and evaluation of other tools which might be added later.

2) Involve Russia and Norway in the MPF procurement selection and again in the design and construction phase reviews to ensure that all regulatory hurdles have been addressed at the earliest possible stages.

3) Resolve indemnification and liability issues or separate them from the design and construction phases so that these can be done under a firm fixed price contract to hold the line on costs.

1999 IN REVIEW

Mission and Vision
The mission of AMEC Project 1.3 is to assess and develop a practical and technically sound process to treat solid radioactive waste (SRW) resulting from the decommissioning of Russian nuclear submarines. The vision is that implemented processes should be a self-sustaining activity of the Russian Federation, and be integrated with the development of SRW containment means for long term storage (AMEC Project 1.4).



Submarine sarcophagus – photo courtesy T. Grochowski

Brief History

Solid radioactive waste from nuclear submarine decommissioning is a significant problem, the complete solution of which is probably well beyond the capabilities of AMEC Project 1.3. Initial estimates for an integrated facility providing metal decontamination and recycle, super-compaction, vitrification, incineration, and cementation of wastes approached \$100 M. Later based on a number of reports provided under contract by ICC Nuclide, the scope was reconsidered and reduced, and the costs refined to about \$20 to \$40 M to include metal decontamination and recycle, super-compaction and cementation. A recommendation report on applicable technologies and an implementation approach was issued in August 1998 which concluded the initial technology evaluation phase.

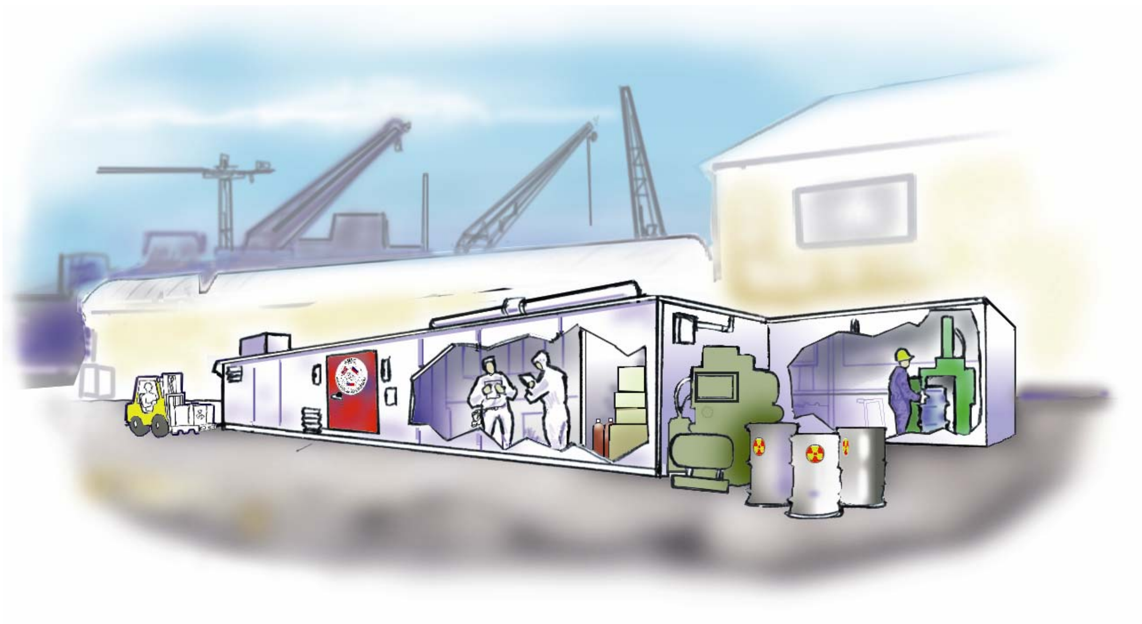
Solid waste compartment in Paldiski– photo courtesy T. Grochowski

The planned implementation phase consisted of two parts – beginning with limited implementation to deploy cutting/shearing, waste handling, and low force compaction at a number of Russian shipyard sites. Each shipyard deployment was envisioned to include a skid steer tractor with various attachments including a hydraulic shearing implement and low force in drum compaction to reduce waste volume. This was to be followed, pending funding availability, by full implementation consisting of metal decontamination, supercompaction and cementation of liquid and solid radioactive waste from these two operations.

Turning Point

A Joint 1.3/1.4 Project Officer meeting was held in conjunction with Waste Management 99 in Tucson, AZ. This was the first time for these Russian representatives to actually see some of the technologies which the US employs for waste management activities and talk directly with vendors. This provided a brief opportunity to quickly assess how these technologies might be employed to meet the many needs of the Russian Navy, and thereby served to catalyze the concept for a mobile facility. From this meeting emerged a joint consensus that such a facility could provide a significant first step to stabilize the backlog of solid wastes at several Russian Arctic shipyards.

The resulting new approach is a novel mobile SRW Pretreatment Facility. A key feature of the concept is the mobility aspect, which will allow this system to be transported between the shipyards such as Nerpa, and other intermediate storage sites such as Gremikha and Andreeva Bay. At these sites the largest portions of the SRW on the Kola Peninsula are located and will be generated in the future. The proposed system can be set up in close proximity to the waste source and allow pretreatment unit operations using commercially available technologies of contaminant assaying, cutting/shearing, sorting/segregation, shredding and low force compaction. This will permit the Russian Navy to begin to volume reduce the large amounts of waste at these locations which currently present not only a bottleneck to the future dismantlement of SSBNs, but also present a significant environmental and health and safety threat.



The mobility concept will be achieved via the use of ISO type or equivalent containers as modular units to house the various unit operations. The containers will be designed in size and modularity to be easily disassembled and loaded onto ship, train or truck, and be moved to prepared sites at each of these facilities where they can quickly be reinstalled. Mobile does not imply these modules be on wheels or tracks, rather the modules can be disconnected and loaded onto whatever mode of transportation is required. While in operation at a site, the modules could be situated within another structure or outside, but in either case would be securely anchored to a concrete pad. Design specifications would include ability to withstand up to 100 mile per hour (45m/s) winds and snow loading of up to 41 pounds per square foot (200kg/m^2). The present concept consists of three modules, two for the actual pretreatment operations and one for worker dress out and sanitation necessities.

Coordination Issues

There is need for significant coordination and cooperation with AMEC Project 1.4 whose mission is the interim storage of SRW. Storage issues come into play both at the front end of Project 1.3 as a way of introducing the feed to any treatment facility and at the back end as containers for the treated waste awaiting final disposal. Therefore coordination of efforts is essential to ensure compatibility of systems put in place by the two projects. In fact, the Project Officers of the two projects were requested to consider merging the two projects into one. However, during the joint 1.3/1.4 Project Officer meeting held in Tucson, AZ, it was mutually agreed that there was significant differences in the work scope, schedules, and skills required. It was believed that greater resources could be brought to bear if the two projects remained separate, but continued to closely coordinate all efforts.

Also, AMEC needs to maintain coordination with the Cooperative Threat Reduction program that is conducting similar projects on solid radioactive waste treatment throughout Russia in direct support of SSBN dismantlement. To date these activities are mainly centered in the Archangel'sk region of the Russian Northern Fleet operations. However, they are much further along in actual deployment of equipment and technologies. Therefore, there is much to be gained in experience while avoiding duplication of efforts.

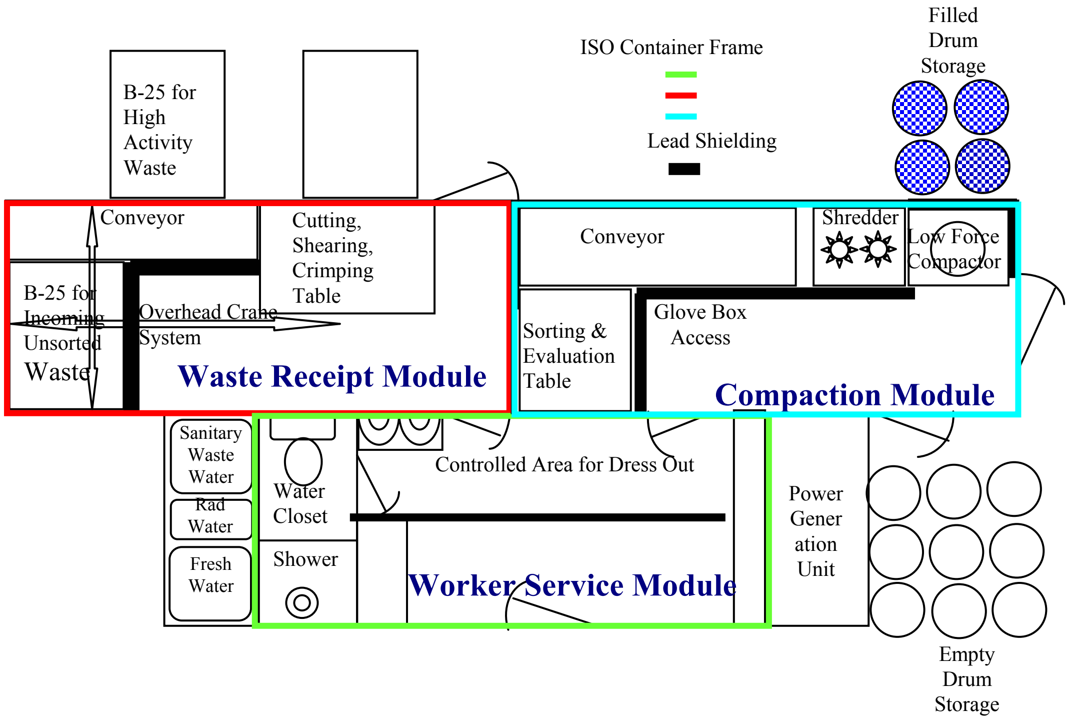
Significant Changes

During the last year and a half, there have been a number of changes in the project including key personnel. The Russian Federation Project Officer has changed from Col. Alexander Diashev to Capt. Victor Kovalenko and most recently to Capt. Vladimir Balkunov. The Norwegian Project Officer responsibility was transferred from Capt. Ragnar Hoff to Dr. Thor Engoy, and the US Project Officer responsibility from Capt. Mark Wrobel to Dr. Barry Spargo of NRL. In addition there have been some changes in the supporting technical personnel. Although this has been a problem for continuity, it has introduced new approaches and ideas into the project. Also, a clearer expectation of funding sources and availability for the next several years has emerged from the US point of view such that a realistic scope is now in hand.

Project Delays

Although a detailed and aggressive task profile management plan was developed in Tucson, the developing crisis in Kosovo and uncertainties regarding renewal of the CTR Umbrella Agreement, quickly made that plan unachievable. Direct communications were cut off for several months and a number of key Steering Group meetings were postponed. Therefore, although the technical specifications that are required to issue a request for proposals were drafted by the Russian Navy in April, the task profile management plan was not approved until much later in August. Release of the MPF technical specifications was to be the Russian contribution to the project. However, ICC Nuclide made it contingent upon these approvals and the negotiation/signing of a contract for the preliminary design review which only occurs much later in the overall schedule of events. This misunderstanding regarding the sequencing of required activities and contracting by ICC Nuclide was not identified at the Tucson meeting. Also resolution and movement of funding took longer than expected on the US side, and is still not resolved for Norway pending the conclusion of a Russia/Norway bilateral agreement. The net effect of this was a delay of about 5 months from the planned schedule.

1999 Accomplishments
As a result of the discussions in Tucson and creation of the MPF concept, a number of accomplishments are described as follows despite the delays which have been noted:



- Compiled a source book of technologies that could potentially be deployed for the limited implementation phase. This included contact information for the various vendors as well as product specifications and performance data. This also included selected videos of the equipment in action to facilitate capability information transfer to the Russians. This information was also an input to the Tucson meeting.
- Developed a conceptual design for the MPF consisting of three to four modules based on modular ISO containers. The design would include a Waste Receipt Module for initial assay, course cutting and shearing, and segregation of wastes, a Compaction Module for further sorting, shredding, and compaction, and a Worker Service Module for sanitary needs and supporting power requirements. An additional module for metal decontamination is a further option under consideration.
- Issued and completed a Request for Information from which 12 companies interested and capable of design and construction of the MPF were identified. A synopsis of the RFI responses was prepared to share with the Norwegian and Russian partners.
- Developed preliminary cost estimates independently by WPI (US) and IFE (Norway) for the MPF for about \$1.25M. This compares to an averaged cost estimate from the RFI at about \$1.34M
- Completed a technical assessment on cutting and shearing technologies that would support the MPF concept. The technical assessment recommends the purchase of

hand-held hydraulically-operated cutting and shearing equipment specifically designed for D&D applications.


Photo courtesy Mega-Tech Services, Inc.

- Negotiated a contract September 3, 1999 with ICC Nuclide (designated Russian technical contractor) for release of the technical specifications, and their review of a US designed MPF versus the technical specifications and expected regulatory requirements.
- Submitted a paper on Project 1.3 and specifically the MPF which was accepted for the International Conference on Environmental Radioactivity in the Arctic to be held in Edinburgh, Scotland on September 20 to 23, 1999.

Current Situation Analysis
Now that communications between the US and Russia are back to near normal, Project 1.3 is prepared to coordinate information exchange and actions to issue an RFP to those companies who responded to the initial RFI. The outcome will be a competitive process to select the best value vendor team based upon capabilities, experience, and technical merit. The decision will be coordinated among all parties to ensure full buy in and avoid any difficulties later once the MPF has been constructed and is ready for deployment.

Although the scope is considerably reduced from the CPF it is still a major financial undertaking for the AMEC program that will require careful coordination and commitment of funds over several years. Therefore the MPF procurement has been broken into a design phase which will largely be funded with US FY99 dollars and a construction phase to be funded with FY00 dollars. A large unknown yet is the contribution from Norway and timing of those funds contingent upon signing of their bilateral agreement with Russia. The final cost of the MPF must be negotiated and will be a function of the selection process and design refinements. Also there will be additional costs associated with start up and training during some period of pilot operations. It is expected that these operational costs would be largely borne by the Russians as they assume full responsibility for the continued operations and maintenance of the MPF on a day to day basis.

An independent cost assessment was prepared by WPI (the US technical contractor) and the Institute for Energy Technology (the Norwegian technical contractor). This was compared versus an averaged cost assessment resulting from the RFI responses that came

within about 10% on the total project cost. This fact provides some comfort that the project scope is reasonable within the projected funding profile for the next several years. However, the variability on the vendor provided estimates is large which indicates a high degree of uncertainty on the vendors part particularly in dealing with unknowns concerning licensing/acceptance and indemnification/liability issues in Russia. In the licensing/acceptance area documented experience from other non-AMEC Russian projects has shown that design modifications to satisfy regulatory approvals can rapidly escalate costs and prolong schedules. That is why up front involvement and planning by all parties and particularly the Russians for a facility that will be constructed outside of Russia are so critical to success. The indemnification/liability issue is addressed under the CTR umbrella agreement but has not really been tested as yet. This issue needs to more thoroughly explored so that the procurement process can proceed under a firm fixed price contract to hold the line on costs and level the playing field for large and small vendors.

The expected timeframe for deployment of the MPF is likely over a year away and will depend on the outcome of the procurement process and selection. Another factor to consider is the limited window of opportunity for getting equipment delivered and set up in the Russian Arctic. Depending on actual construction completion, one option would be to transport the MPF to a more temperate climate at St. Petersburg for initial shakedown and training and non-rad wastes, before final delivery and deployment at a shipyard.

In the interim until the MPF can be deployed, there is still the need for additional cutting and shearing capabilities supporting D&D operations in the shipyards. An initial deployment of selected cutting and shearing equipment will provide the opportunity for a demonstration of this equipment, training on its use and maintenance, and preliminary evaluation of what additional capabilities might be needed to fully support the MPF operations in the future. This equipment can be deployed within a short period of time for a minor cost. It would demonstrate real progress in the short run and can later be joined with the MPF to support its operations.

The engineering assessment of the CPF needs to be done in tandem with the development of the MPF since the MPF will be a significant feed source of pretreated and containerized waste to the CPF. This will ensure compatibility of processes and operations to minimize any rework of wastes or to ensure that one facility does not create problems for the other. The two need to function as a system and systems engineering techniques should be employed to ensure smooth operations between the two facilities and with the interim storage containers and facilities being developed under Project 1.4.

2000 Projected Accomplishments

- Hold Joint 1.3/1.4 Project Officers meeting in St. Petersburg, Russia in early Spring to discuss initial deployment of cutting and shearing equipment at a Russian shipyard and continue coordination of the two projects.
- Select best value vendor and award a contract to a US firm to develop a detailed engineering design.
- ICC Nuclide to provide a review and assessment versus the technical specifications and expected regulatory requirements.
- Develop report on rapid deployment of cutting and shearing equipment performance.
- Based on design feedback finalize design and exercise option to construct the MPF.
- Award contract to ICC Nuclide to manage deployment site preparations including pad construction.
- ICC Nuclide to complete technical engineering assessment for Central Processing Facility.

Financial Highlights

Planned US funding for Project 1.3 based on the FY99 Report to Congress is as follows. However all FY98 Project 1.3 dollars were shifted to Project 1.1 for spent nuclear fuel cask development to accelerate that project. Those funds should be repaid to Project 1.3 in the outyears.

	FY 97	FY98	FY 99	FY 00	FY 01	FY 02	Total
US Project Requirements	$727K	$600K	$400K	$1,600K	$1,200K	$800K	$5,327

Norwegian contributions and timing of funds are unknown at this point as mentioned previously pending resolution of their bilateral agreement. To this point no Norwegian funding for capital projects or equipment has been contributed other than time of the Project Officer and the technical support contractor for meetings.

Through the end of FY99 a total of $814K has been authorized to WPI as the US technical contractor under Project 1.3 for direct project management and technical support. This is a combination of FY97 and FY99 funds with a portion of the FY97 funds being captured from the closeout of AMEC Project 2.1. The FY97 funds of $504K were allocated through a DoD contract to the Air Force Center for Environmental Excellence (AFCEE). FY99 funding of $310K is currently allocated through a DOE contract to the Federal Energy Technology Center (FETC).

As of the end of FY99 $482K is projected to be spent. Of the remaining funds $150K is reserved for upcoming procurements - $75K for the procurement of the cutting and shearing equipment and another $75K for the design phase of the MPF which will commence as soon as the technical specifications are released. Also, to date a total of $25K has been subcontracted to the Russian designated technical contractor ICC Nuclide - $15K under an initial subcontract during the technical assessment phase, and another

$10K recently obligated under a second subcontract for preliminary design review. Further obligations to ICC Nuclide are planned from future funds in support of regulatory clearances and site preparation for the MPF. Other remaining carryover funds will be used for continued project technical support for the procurements and meeting travel through the end of the calendar year until FY00 funding is available.